PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-322179
(43)Date of publication of application : 08.12.1995

(51)Int.CI. H04N 5/66
H04N 5/66
H04N 5/57

(21)Application number : 06-136310
(22)Date of filing : 26.05.1994

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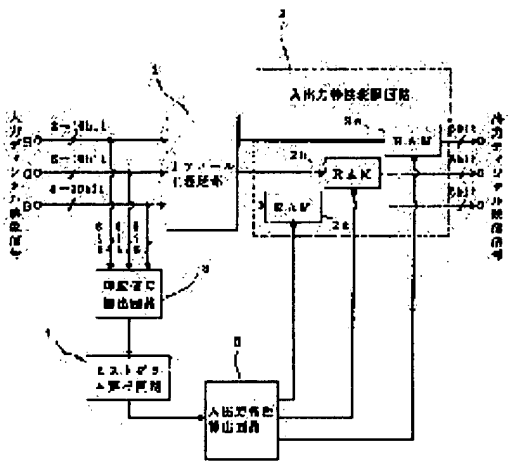
(54) VIDEO DISPLAY PROCESSING METHOD FOR ELECTRONIC DISPLAY AND ITS DEVICE

(57)Abstract:
PURPOSE: To suppress the black and white collapses of a screen, to improve the contrast of the screen and to improve image quality when video is displayed on electronic displays such as an LCD and a PDP, etc.
CONSTITUTION: This method and device are a video display processing method and its device in which video is possible to be displayed by performing an input/output characteristic conversion for an input video signal according to the characteristic of an electronic display. A one-field delay is performed for an input video signal (RGB digital video signal) in a one-field delay part 1 and the luminance signal of the input video signal is detected in a luminance signal detection circuit 3. By the luminance signal, the same signal level is counted in a histogram calculation circuit 4 and the histogram of the video signal is prepared for every field. In an input/output characteristic calculation circuit 5, the input/output characteristic data of an input/ output characteristic conversion circuit 2 according to the average value (APL ; average video level) and the dispersion (or standard deviation) of the histogram is calculated. The sum total of the histogram is calculated, it is added to the input/output characteristic data by a prescribed ratio and the final input/output characteristic data of the input/output characteristic conversion circuit 2 is obtained.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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CLAIMS

[Claim(s)]
[Claim 1] When carrying out input-output-behavioral-characteristics conversion of the input video signal according to the property of an electronic display, Count the number of pixels for every signal level of this with this input video signal, and a histogram is created. Obtain the average value of the created this histogram, and distribution, and input-output-behavioral-characteristics data are determined based on this profit **** average value or distribution. The graphic display art of the electronic display characterized by having computed **** of said histogram, having added this **** to said input-output-behavioral-characteristics data at a predetermined rate, and considering as the data for said input-output-behavioral-characteristics conversion.
[Claim 2] It is the graphic display art of the electronic display which carries out input-output-behavioral-characteristics conversion of the input video signal according to the property of an electronic display. said input video signal -- the 1 field -- or, while one frame is delayed Detect the luminance signal of said input video signal, count the number of pixels for every same signal level of a video signal with the this detected luminance signal, and a histogram is created. Compute the average value of the created this histogram, and distribution, and input-output-behavioral-characteristics data are computed according to this average value and distribution. Compute **** of said histogram, add to said input-output-behavioral-characteristics data at a predetermined rate according to separation of this ****, and it is considering as the data for said input-output-behavioral-characteristics conversion. The graphic display art of the electronic display characterized by carrying out input-output-behavioral-characteristics conversion of said 1 field or video signal delayed one frame using these data.
[Claim 3] It is the graphic display processor of the electronic display which carries out input-output-behavioral-characteristics conversion of the input video signal according to the property of an electronic display. Said input video signal The 1 field or a delay means by which one frame is delayed, A luminance-signal detection means to detect the luminance signal of said input video signal, and a histogram calculation means to compute a histogram by considering the number of pixels as a count for every same signal level of a video signal with the this detected luminance signal, Compute the average value of the computed this histogram, and distribution, and input-output-behavioral-characteristics data are computed according to the this computed average value. The input-output-behavioral-characteristics calculation means which adds to said input-output-behavioral-characteristics data computed previously at a predetermined rate according to separation of said histogram, and is acquired with the data for said input-output-behavioral-characteristics conversion, the graphic display processor of the electronic display characterized by having the input-output-behavioral-characteristics conversion means which carries out input-output-behavioral-characteristics conversion of the video signal delayed by said delay means with the data for this profit **** input-output-behavioral-characteristics conversion according to the property of said electronic display.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the graphic display processing technique in the electronic displays (LCD (liquid crystal display panel), PDP (plasma display panel), etc.) used for television etc., and relates to the graphic display art of the electronic display which attains high definition-ization of an electronic display in detail especially, and its equipment.
[0002]
[Description of the Prior Art] When displaying the image by the input video signal on an electronic display, for example, a liquid crystal display panel (it is described as Following LCD) and a plasma display panel (it is described as Following PDP), according to the properties (gamma property etc.) of an electronic display, signal processing of the input video signal is carried out to predetermined.
[0003] If it is in this signal processing, generally input-output-behavioral-characteristics transform processing for a gamma correction is performed, for example to the video signal (RGB digital video signal) of television etc., and the display of the proper image by this video signal to an electronic display is enabled.
[0004]
[Problem(s) to be Solved by the Invention] By the way, it is difficult for the actual condition for LCD and PDP to run short of the contrast and the brightness of the display image generally among the above-mentioned electronic displays as compared with other electronic displays, and to acquire a good image.
[0005] Moreover, in the above-mentioned electronic display, in order to stop power consumption uniformly in consideration of a life etc., when not bright on the whole (i.e., when dark in the whole screen), the brightness of the peak of a display image also becomes [a display image] low, the image quality of a display image deteriorates, for example, it will be in the condition of black crushing.
[0006] This invention can be made in view of the above-mentioned technical problem, and that object can suppress black crushing of a display image, and white crushing, and the contrast of a screen can be improved, and it is in offering the graphic display art of the electronic display which enabled it to acquire a high-definition image, and its equipment.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned object, the graphic display art of the electronic display of this invention, and its equipment When carrying out input-output-behavioral-characteristics conversion of the input video signal according to the property of an electronic display, the number of pixels is counted for every same signal level with this input video signal, a histogram is created, the average value of a histogram and distribution which were this created are obtained, and input-output-behavioral-characteristics data are determined based on this profit **** average value or distribution, and let it be a summary to have considered as the data for said input-output-behavioral-characteristics conversion.
[0008]
[Function] According to the above-mentioned means, the number of pixels counts with a counter for

every same signal level of this input video signal with the luminance signal of an input video signal, and it is totaled by every 1 FIRUDO (or one frame), and the histogram of an input video signal (the same signal level) is created. While the average of this histogram and distribution are computed with an input-output-behavioral-characteristics calculation means, input-output-behavioral-characteristics data are computed based on this average and distribution.

[0009] In this case, although the above-mentioned input-output-behavioral-characteristics data are obtained for example, by y=1/2- (x/c) (gamma **), this c value is determined according to the average of a histogram, and a gamma value is determined according to distribution of a histogram. It is added to the input-output-behavioral-characteristics data which **** of that histogram was computed and were computed by the above place at a predetermined rate according to that separation in this **** on the other hand. Input-output-behavioral-characteristics conversion (a gamma correction is included) of the input of an input video signal is enabled to an electronic display with this input-output-behavioral-characteristics data.

[0010] Thus, since it is determined according to the average of a histogram, and distribution as data for carrying out input-output-behavioral-characteristics conversion of the input video signal, black crushing of a screen is suppressed, and white crushing is suppressed, and an image is acquired for the fitness of contrast.

[0011] And contrast increases more and the image of high contrast is acquired from the distribution condition of a histogram adding to the input-output-behavioral-characteristics data previously computed at a rate predetermined [corresponding to the separation even if as complicated as many crests] in **** of a histogram, and considering as final input-output-behavioral-characteristics data.

[0012]

[Example] The graphic display art of the electronic display of this invention, and its equipment The brightness of a screen etc. can be judged by the average value (APL; average picture level) of the histogram which counts the number of pixels and is obtained for every same signal level of an input video signal (RGB digital video signal), and its distribution (or standard deviation). That is, it notes that the brightness of a screen etc. is reflected in the average and distribution. In order to display the image by the input video signal on an electronic display, when carrying out input-output-behavioral-characteristics conversion of this input video signal, While computing input-output-behavioral-characteristics data based on the APL and distribution, **** of the histogram is computed, respectively, each **** is added to previous input-output-behavioral-characteristics data at a predetermined rate, and the data for the above-mentioned input-output-behavioral-characteristics conversion are determined as every 1 field (or one frame).

[0013] As shown in drawing 1 , therefore, the graphic display processor of this electronic display 1 field delay section 1 delayed the 1 field in an input video signal (RGB digital video signal), RAM2a for performing input-output-behavioral-characteristics transform processing (gamma correction etc.) to this delayed video signal, 2b, and the input-output-behavioral-characteristics conversion circuit 2 that consists of 2c, The luminance-signal detector 3 which detects the luminance signal of an input video signal, and the histogram calculation circuit 4 which computes a histogram for every field by counting the number of pixels for every signal level of a video signal with this detected luminance signal, The average value of this computed histogram, i.e., APL, (average picture level), and distribution (or standard deviation) are computed. While computing input-output-behavioral-characteristics data based on these APL and distribution It has the input-output-behavioral-characteristics calculation circuit 5 which computes **** of a histogram, and computes the final input-output-behavioral-characteristics data (data for carrying out input-output-behavioral-characteristics conversion of the video signal) of the input-output-behavioral-characteristics conversion circuit 2 by adding this **** to the input-output-behavioral-characteristics data previously computed at a predetermined rate according to the separation.

[0014] In addition, a histogram is computed to the level of each input video signal, as shown in the continuous-line curve of drawing 2 , and the broken-line curve of drawing 3 .

[0015] Next, if actuation of the graphic display processor of the electronic display of the above-mentioned configuration is explained in detail with reference to drawing 2 and property drawing of

drawing 3 , the image by the RGB digital video signal (RGB video signal (8 bits thru/or 10 bits)) which carried out predetermined processing of the television signal (NTSC signal), for example shall be displayed on electronic displays (LCD, PDP, etc.).
[0016] At this time, 1 field of 1 field delay sections 1 is delayed, and they output that RGB digital video signal (it is described as an input video signal below) to the input-output-behavioral-characteristics conversion circuit 2. On the other hand, the luminance-signal detector 3 inputs 6 of an input video signal thru/or the data for 8 bits (a high order 6 thru/or 8 bit data), and detects the luminance signal of this input video signal. The histogram calculation circuit 4 is a counter, and counts the number of signals for every same signal level of an input video signal with the detected luminance signal, and totals it for every field, and creates a histogram (for example, shown in drawing 2).
[0017] In addition, when an input video signal is what is depended on an NTSC signal, the luminance signal Y detected in the luminance-signal detector 3 is usually the rate of Y=0.30R+0.59G+0.11B, but in this invention, even if that luminance signal is Ya=R+G+B, the almost same effectiveness is acquired.
[0018] Moreover, input-output-behavioral-characteristics conversion is carried out, and when output signals, i.e., the signal to output, are 8 bit patterns, 6 bits thru/or 8 bits of the signal level for creating the histogram are enough.
[0019] furthermore -- when displaying the image by the NTSC signal by general 480x680 pixels, even if the pixel block for obtaining the frequency (output level) of the histogram sets a 32x32-pixel block to one, that is, computes APL and a variance by making 1 pixel of the pixel block into representation -- the above -- it is not so much different from the case of the histogram which counts the number of pixels and is obtained for every same signal level. Therefore, you may make it compute a histogram by taking 1 pixel from 1/16x1/16 thru/or 1 / 32x1 / 32 pixels.
[0020] The input-output-behavioral-characteristics calculation circuit 5 determines the gamma value (0.1-6.0) of input-output behavioral characteristics according to this distribution, and determines the value c from which the output level of the equipment concerned is set to the one half [greatest] according to that APL while it computes that distribution and APL with the histogram computed for every above-mentioned field. Furthermore, based on the gamma value and value c which were they-determined, the data for input-output-behavioral-characteristics conversion will be computed by the one following, and it will write in each RAM2a of the input-output-behavioral-characteristics conversion circuit 2, 2b, and 2c, respectively.
[0021]
[Equation 1]

$$y = \frac{1}{2} \times \left(\frac{x}{c}\right)^{\gamma}$$

In one above, the value and gamma from which the output level of input-output-behavioral-characteristics conversion and x are set to the input level of input-output-behavioral-characteristics conversion, and c is set to y=1/2 by y mean gamma (gamma) value.
[0022] In this case, in the input-output-behavioral-characteristics calculation circuit 5, once memorizing the histogram by which calculation was carried out [above-mentioned] to internal RAM, according to the fixed formula which incorporates the data of this RAM for a data-processing means (MPU), and is shown in one above, the value (data) of input-output behavioral characteristics is calculated. In addition, what is necessary is just to use the formula of the ellipse smoothly connected with one above by one above, when the predetermined value (data) of a high level exceeds an output level.
[0023] On the other hand, **** of a histogram is added to the input-output-behavioral-characteristics data (input-output-behavioral-characteristics data computed by several 1) previously computed at a predetermined rate according to the degree of separation.
[0024] When a histogram is the form shown in the continuous-line curve of drawing 2 as a result, it considers as the input-output-behavioral-characteristics data which the gamma value of the input-output behavioral characteristics of the place (part shown in the arrow heads A and B of this drawing) by **** of a histogram becomes large, that is, are shown in the continuous-line curve of drawing 3 . In addition,

in case it adds at an above-mentioned predetermined rate, according to separation of the histogram of each crest, it considers as a fixed rate, separation of the histogram of an output becomes excessive, and it is made not to spoil the image by the original video signal.
[0025] The input-output-behavioral-characteristics data shown in the continuous line of this drawing 3 are written in each RAM2a of the input-output-behavioral-characteristics conversion time 2, 2b, and 2c for every field, and input-output-behavioral-characteristics conversion of the input video signal by which 1 field delay is carried out is carried out according to that input-output-behavioral-characteristics data. Therefore, the contrast of a display image will be reinforced, that is, contrast will be improved.
[0026] Thus, in case input-output-behavioral-characteristics conversion of the input video signal is carried out according to the property of an electronic display, it creates the histogram of this video signal for every field with the luminance signal of an input video signal (RGB digital video signal), and based on distribution and APL of this histogram, according to separation of that histogram, it adds that **** to the input-output-behavioral-characteristics data of an above place at a predetermined rate, and it not only computes input-output-behavioral-characteristics data, but obtains the final input-output-behavioral-characteristics data of the input-output-behavioral-characteristics conversion circuit 2.
[0027] therefore -- for example, even if it is electronic DIPUREI, such as PDP with a small dynamic range, black crushing of a display image and white crushing can be suppressed, the contrast of a display image can be improved, as a result a high-definition image can be acquired.
[0028] Even when a histogram is the form of many crests, the contrast of a display image is reinforced, that is, the contrast of a screen can be improved, and, moreover, the image of near and high contrast is extremely obtained by the subject-copy image.
[0029] For example, as shown in the broken-line curve of drawing 3 , when separation of a histogram is large, as the component of the input-output behavioral characteristics by **** of a histogram increases, that is, it is shown in the continuous-line curve of this drawing, the gamma value of the part corresponding to each crest is large, and it is because the gamma value of the part between each crest becomes small at reverse.
[0030] In addition, although the input-output-behavioral-characteristics data of the input-output-behavioral-characteristics conversion circuit 2 are computed for every field of an input video signal and input-output-behavioral-characteristics conversion (a gamma correction is included) of the input video signal is carried out for every field of this in the above-mentioned example, you may make it obtain the data of input-output behavioral characteristics for every frame of an input video signal. In this case, that configuration that can be processed for every frame then the same operation as the above-mentioned example, and effectiveness can be acquired for each circuit.
[0031]
[Effect of the Invention] As explained above, this invention is the graphic display art of the electronic display which carries out input-output-behavioral-characteristics conversion according to the property of an electronic display, and enables the display of an image of an input video signal, and its equipment. In order to display the image by the input video signal on an electronic display, when carrying out input-output-behavioral-characteristics conversion of this input video signal, While computing input-output-behavioral-characteristics data based on the APL and distribution Since **** of the histogram is added to previous input-output-behavioral-characteristics data at a predetermined rate according to separation and the data for the above-mentioned input-output-behavioral-characteristics conversion were determined as every 1 field (or one frame) For example, even if it is electronic DIPUREI, such as PDP with a small dynamic range Black crushing of a display image and white crushing can be suppressed, and the contrast of a display image can be improved. As a result, a high-definition image can be acquired, and even when a histogram is the form of many crests, the contrast of a display image is reinforced, that is, the contrast of a screen can be improved, and, moreover, the image of near and high contrast is extremely obtained by the subject-copy image.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention relates to the graphic display processing technique in the electronic displays (LCD (liquid crystal display panel), PDP (plasma display panel), etc.) used for television etc., and relates to the graphic display art of the electronic display which attains high definition-ization of an electronic display in detail especially, and its equipment.

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PRIOR ART

[Description of the Prior Art] When displaying the image by the input video signal on an electronic display, for example, a liquid crystal display panel (it is described as Following LCD) and a plasma display panel (it is described as Following PDP), according to the properties (gamma property etc.) of an electronic display, signal processing of the input video signal is carried out to predetermined.
[0003] If it is in this signal processing, generally input-output-behavioral-characteristics transform processing for a gamma correction is performed, for example to the video signal (RGB digital video signal) of television etc., and the display of the proper image by this video signal to an electronic display is enabled.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, this invention is the graphic display art of the electronic display which carries out input-output-behavioral-characteristics conversion according to the property of an electronic display, and enables the display of an image of an input video signal, and its equipment, and in order to display the image by the input video signal on an electronic display, in case it carries out input-output-behavioral-characteristics conversion of this input video signal, it computes input-output-behavioral-characteristics data based on that APL and distribution. On the other hand, since **** of the histogram is added to previous input-output-behavioral-characteristics data at a predetermined rate according to separation and the data for the above-mentioned input-output-behavioral-characteristics conversion were determined as every 1 field (or one frame) For example, even if it is electronic DIPUREI, such as PDP with a small dynamic range Black crushing of a display image and white crushing can be suppressed, and the contrast of a display image can be improved. As a result, a high-definition image can be acquired, and even when a histogram is the form of many crests, the contrast of a display image is reinforced, that is, the contrast of a screen can be improved, and, moreover, the image of near and high contrast is extremely obtained by the subject-copy image.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, it is difficult for the actual condition for LCD and PDP to run short of the contrast and the brightness of the display image generally among the above-mentioned electronic displays as compared with other electronic displays, and to acquire a good image. [0005] Moreover, in the above-mentioned electronic display, in order to stop power consumption uniformly in consideration of a life etc., when not bright on the whole (i.e., when dark in the whole screen), the brightness of the peak of a display image also becomes [a display image] low, the image quality of a display image deteriorates, for example, it will be in the condition of black crushing. [0006] This invention can be made in view of the above-mentioned technical problem, and that object can suppress black crushing of a display image, and white crushing, and the contrast of a screen can be improved, and it is in offering the graphic display art of the electronic display which enabled it to acquire a high-definition image, and its equipment.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, the graphic display art of the electronic display of this invention, and its equipment When carrying out input-output-behavioral-characteristics conversion of the input video signal according to the property of an electronic display, the number of pixels is counted for every same signal level with this input video signal, a histogram is created, the average value of a histogram and distribution which were this created are obtained, and input-output-behavioral-characteristics data are determined based on this profit **** average value or distribution, and let it be a summary to have considered as the data for said input-output-behavioral-characteristics conversion.

[Translation done.]

OPERATION

[Function] According to the above-mentioned means, the number of pixels counts with a counter for every same signal level of this input video signal with the luminance signal of an input video signal, and it is totaled by every 1 FIRUDO (or one frame), and the histogram of an input video signal (the same signal level) is created. While the average of this histogram and distribution are computed with an input-output-behavioral-characteristics calculation means, input-output-behavioral-characteristics data are computed based on this average and distribution.
[0009] In this case, although the above-mentioned input-output-behavioral-characteristics data are obtained for example, by y=1/2- (x/c) (gamma **), this c value is determined according to the average of a histogram, and a gamma value is determined according to distribution of a histogram. It is added to the input-output-behavioral-characteristics data which **** of that histogram was computed and were computed by the above place at a predetermined rate according to that separation in this **** on the other hand. Input-output-behavioral-characteristics conversion (a gamma correction is included) of the input of an input video signal is enabled to an electronic display with this input-output-behavioral-characteristics data.
[0010] Thus, since it is determined according to the average of a histogram, and distribution as data for carrying out input-output-behavioral-characteristics conversion of the input video signal, black crushing of a screen is suppressed, and white crushing is suppressed, and an image is acquired for the fitness of contrast.
[0011] And contrast increases more and the image of high contrast is acquired from the distribution condition of a histogram adding to the input-output-behavioral-characteristics data previously computed at a rate predetermined [corresponding to the separation even if as complicated as many crests] in **** of a histogram, and considering as final input-output-behavioral-characteristics data.

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EXAMPLE

[Example] The graphic display art of the electronic display of this invention, and its equipment The brightness of a screen etc. can be judged by the average value (APL; average picture level) of the histogram which counts the number of pixels and is obtained for every same signal level of an input video signal (RGB digital video signal), and its distribution (or standard deviation). That is, it notes that the brightness of a screen etc. is reflected in the average and distribution. In order to display the image by the input video signal on an electronic display, when carrying out input-output-behavioral-characteristics conversion of this input video signal, While computing input-output-behavioral-characteristics data based on the APL and distribution, **** of the histogram is computed, respectively, each **** is added to previous input-output-behavioral-characteristics data at a predetermined rate, and the data for the above-mentioned input-output-behavioral-characteristics conversion are determined as every 1 field (or one frame).
[0013] As shown in drawing 1 , therefore, the graphic display processor of this electronic display 1 field delay section 1 delayed the 1 field in an input video signal (RGB digital video signal), RAM2a for performing input-output-behavioral-characteristics transform processing (gamma correction etc.) to this delayed video signal, 2b, and the input-output-behavioral-characteristics conversion circuit 2 that consists of 2c, The luminance-signal detector 3 which detects the luminance signal of an input video signal, and the histogram calculation circuit 4 which computes a histogram for every field by counting the number of pixels for every signal level of a video signal with this detected luminance signal, The average value of this computed histogram, i.e., APL, (average picture level), and distribution (or standard deviation) are computed. While computing input-output-behavioral-characteristics data based on these APL and distribution It has the input-output-behavioral-characteristics calculation circuit 5 which computes **** of a histogram, and computes the final input-output-behavioral-characteristics data (data for carrying out input-output-behavioral-characteristics conversion of the video signal) of the input-output-behavioral-characteristics conversion circuit 2 by adding this **** to the input-output-behavioral-characteristics data previously computed at a predetermined rate according to the separation.
[0014] In addition, a histogram is computed to the level of each input video signal, as shown in the continuous-line curve of drawing 2 , and the broken-line curve of drawing 3 .
[0015] Next, if actuation of the graphic display processor of the electronic display of the above-mentioned configuration is explained in detail with reference to drawing 2 and property drawing of drawing 3 , the image by the RGB digital video signal (RGB video signal (8 bits thru/or 10 bits)) which carried out predetermined processing of the television signal (NTSC signal), for example shall be displayed on electronic displays (LCD, PDP, etc.).
[0016] At this time, 1 field of 1 field delay sections 1 is delayed, and they output that RGB digital video signal (it is described as an input video signal below) to the input-output-behavioral-characteristics conversion circuit 2. On the other hand, the luminance-signal detector 3 inputs 6 of an input video signal thru/or the data for 8 bits (a high order 6 thru/or 8 bit data), and detects the luminance signal of this input video signal. The histogram calculation circuit 4 is a counter, and counts the number of signals for every same signal level of an input video signal with the detected luminance signal, and totals it for

every field, and creates a histogram (for example, shown in drawing 2).
[0017] In addition, when an input video signal is what is depended on an NTSC signal, the luminance signal Y detected in the luminance-signal detector 3 is usually the rate of Y=0.30R+0.59G+0.11B, but in this invention, even if that luminance signal is Ya=R+G+B, the almost same effectiveness is acquired.
[0018] Moreover, input-output-behavioral-characteristics conversion is carried out, and when output signals, i.e., the signal to output, are 8 bit patterns, 6 bits thru/or 8 bits of the signal level for creating the histogram are enough.
[0019] furthermore -- when displaying the image by the NTSC signal by general 480x680 pixels, even if the pixel block for obtaining the frequency (output level) of the histogram sets a 32x32-pixel block to one, that is, computes APL and a variance by making 1 pixel of the pixel block into representation -- the above -- it is not so much different from the case of the histogram which counts the number of pixels and is obtained for every same signal level. Therefore, you may make it compute a histogram by taking 1 pixel from 1/16x1/16 thru/or 1 / 32x1 / 32 pixels.
[0020] The input-output-behavioral-characteristics calculation circuit 5 determines the gamma value (0.1-6.0) of input-output behavioral characteristics according to this distribution, and determines the value c from which the output level of the equipment concerned is set to the one half [greatest] according to that APL while it computes that distribution and APL with the histogram computed for every above-mentioned field. Furthermore, based on the gamma value and value c which were they-determined, the data for input-output-behavioral-characteristics conversion will be computed by the one following, and it will write in each RAM2a of the input-output-behavioral-characteristics conversion circuit 2, 2b, and 2c, respectively.
[0021]
[Equation 1]

$$y = \frac{1}{2} \times \left(\frac{x}{c}\right)^{\gamma}$$

In one above, the value and gamma from which the output level of input-output-behavioral-characteristics conversion and x are set to the input level of input-output-behavioral-characteristics conversion, and c is set to y=1/2 by y mean gamma (gamma) value.
[0022] In this case, in the input-output-behavioral-characteristics calculation circuit 5, once memorizing the histogram by which calculation was carried out [above-mentioned] to internal RAM, according to the fixed formula which incorporates the data of this RAM for a data-processing means (MPU), and is shown in one above, the value (data) of input-output behavioral characteristics is calculated. In addition, what is necessary is just to use the formula of the ellipse smoothly connected with one above by one above, when the predetermined value (data) of a high level exceeds an output level.
[0023] On the other hand, **** of a histogram is added to the input-output-behavioral-characteristics data (input-output-behavioral-characteristics data computed by several 1) previously computed at a predetermined rate according to the degree of separation.
[0024] When a histogram is the form shown in the continuous-line curve of drawing 2 as a result, it considers as the input-output-behavioral-characteristics data which the gamma value of the input-output behavioral characteristics of the place (part shown in the arrow heads A and B of this drawing) by **** of a histogram becomes large, that is, are shown in the continuous-line curve of drawing 3 . In addition, in case it adds at an above-mentioned predetermined rate, according to separation of the histogram of each crest, it considers as a fixed rate, separation of the histogram of an output becomes excessive, and it is made not to spoil the image by the original video signal.
[0025] The input-output-behavioral-characteristics data shown in the continuous line of this drawing 3 are written in each RAM2a of the input-output-behavioral-characteristics conversion time 2, 2b, and 2c for every field, and input-output-behavioral-characteristics conversion of the input video signal by which 1 field delay is carried out is carried out according to that input-output-behavioral-characteristics data. Therefore, the contrast of a display image will be reinforced, that is, contrast will be improved.
[0026] Thus, in case input-output-behavioral-characteristics conversion of the input video signal is

carried out according to the property of an electronic display, it creates the histogram of this video signal for every field with the luminance signal of an input video signal (RGB digital video signal), and based on distribution and APL of this histogram, according to separation of that histogram, it adds that **** to the input-output-behavioral-characteristics data of an above place at a predetermined rate, and it not only computes input-output-behavioral-characteristics data, but obtains the final input-output-behavioral-characteristics data of the input-output-behavioral-characteristics conversion circuit 2.

[0027] therefore -- for example, even if it is electronic DIPUREI, such as PDP with a small dynamic range, black crushing of a display image and white crushing can be suppressed, the contrast of a display image can be improved, as a result a high-definition image can be acquired.

[0028] Even when a histogram is the form of many crests, the contrast of a display image is reinforced, that is, the contrast of a screen can be improved, and, moreover, the image of near and high contrast is extremely obtained by the subject-copy image.

[0029] For example, as shown in the broken-line curve of drawing 3 , when separation of a histogram is large, as the component of the input-output behavioral characteristics by **** of a histogram increases, that is, it is shown in the continuous-line curve of this drawing, the gamma value of the part corresponding to each crest is large, and it is because the gamma value of the part between each crest becomes small at reverse.

[0030] In addition, although the input-output-behavioral-characteristics data of the input-output-behavioral-characteristics conversion circuit 2 are computed for every field of an input video signal and input-output-behavioral-characteristics conversion (a gamma correction is included) of the input video signal is carried out for every field of this in the above-mentioned example, you may make it obtain the data of input-output behavioral characteristics for every frame of an input video signal. In this case, that configuration that can be processed for every frame then the same operation as the above-mentioned example, and effectiveness can be acquired for each circuit.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The rough partial block diagram of the graphic display processor of the electronic display in which one example of this invention is shown.
[Drawing 2] Rough histogram drawing for explaining actuation of the graphic display processor shown in drawing 1 .
[Drawing 3] Rough input-output-behavioral-characteristics drawing and histogram drawing for explaining actuation of the graphic display processor shown in drawing 1 .
[Description of Notations]
1 1 Field Delay Section
2 Input-output-Behavioral-Characteristics Conversion Circuit
2a,2b,2c RAM
3 Luminance-Signal Detector
4 Histogram Calculation Circuit
5 Input-output-Behavioral-Characteristics Calculation Circuit

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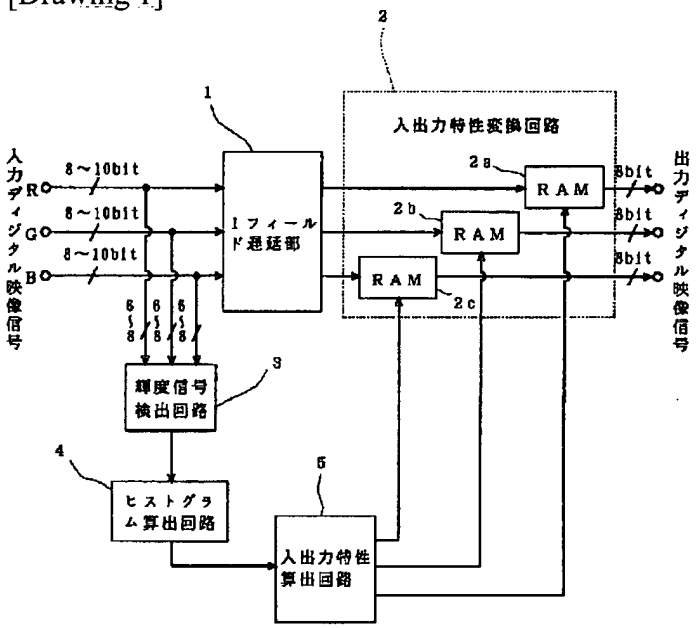
[Translation done.]

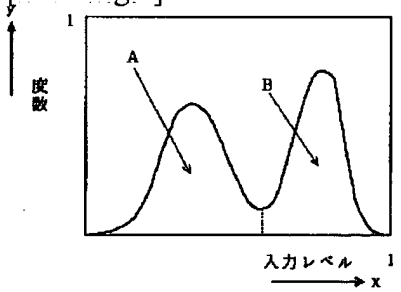
* NOTICES *

DRAWINGS

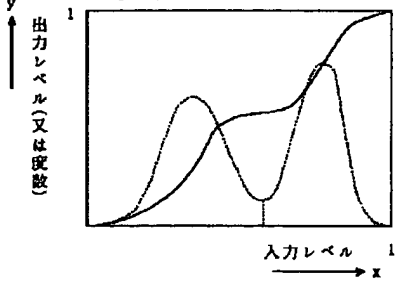
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－322179

(43)公開日　平成７年(1995)12月８日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０４Ｎ	5/66	１０２　Ｚ			
		１０１　Ｚ			
	5/57				

審査請求　未請求　請求項の数３　ＦＤ　（全　５　頁）

(21)出願番号　特願平6－136310

(22)出願日　平成６年(1994)５月26日

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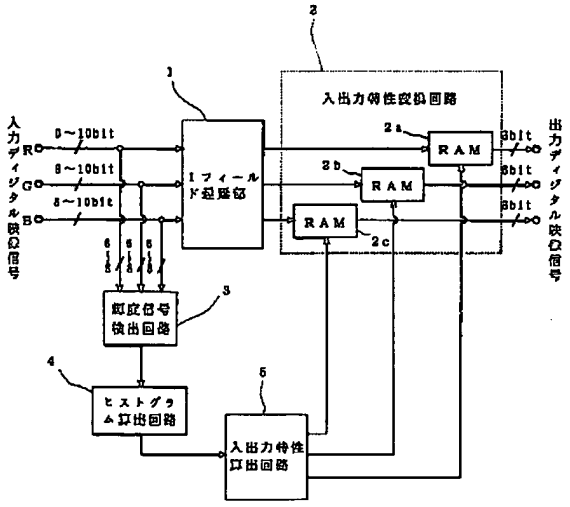
(54)【発明の名称】　電子ディスプレイの映像表示処理方法およびその装置

(57)【要約】

【目的】　ＬＣＤやＰＤＰ等の電子ディスプレイに映像を表示する際、画面の黒つぶれ、白つぶれを抑え、かつ画面のコントラストを改善し、画質の向上を図る。

【構成】　入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換して映像を表示可能とする電子ディスプレイの映像表示処理方法およびその装置であって、入力映像信号（ＲＧＢディジタル映像信号）を１フィールド遅延部１で１フィード遅延する一方、その入力映像信号の輝度信号を輝度信号検出回路３で検出し、この輝度信号により同じ信号レベルをヒストグラム算出回路４でカウントして１フィールド毎に映像信号のヒストグラムを作成し、入出力特性算出回路５でそのヒストグラムの平均値（ＡＰＬ；平均映像レベル）および分散（または標準偏差）に応じた入出力特性変換回路２の入出力特性データを算出し、またヒストグラムの累和を算出し、所定の割合で先の入出力特性データに加算して入出力特性変換回路２の最終的な入出力特性データを得る。



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【特許請求の範囲】

【請求項1】　入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換する際、同入力映像信号により同信号レベル毎に画素数をカウントしてヒストグラムを作成し、該作成されたヒストグラムの平均値や分散を得、該得られた平均値や分散に基づいて入出力特性データを決定し、前記ヒストグラムの累和を算出し、該累和を所定の割合で前記入出力特性データに加算して前記入出力特性変換のためのデータとしたことを特徴とする電子ディスプレイの映像表示処理方法。

【請求項2】　入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換する電子ディスプレイの映像表示処理方法であって、

前記入力映像信号を1フィールドあるいは1フレーム遅延する一方、前記入力映像信号の輝度信号を検出し、該検出された輝度信号により映像信号の同じ信号レベル毎に画素数をカウントしてヒストグラムを作成し、該作成されたヒストグラムの平均値および分散を算出し、該平均値および分散に応じて入出力特性データを算出し、前記ヒストグラムの累和を算出し、該累和の分離に応じた所定の割合で前記入出力特性データに加算して前記入出力特性変換のためのデータとしており、該データを用いて前記1フィールドあるいは1フレーム遅延された映像信号を入出力特性変換するようにしたことを特徴とする電子ディスプレイの映像表示処理方法。

【請求項3】　入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換する電子ディスプレイの映像表示処理装置であって、

前記入力映像信号を1フィールドあるいは1フレーム遅延する遅延手段と、前記入力映像信号の輝度信号を検出する輝度信号検出手段と、該検出された輝度信号により映像信号の同じ信号レベル毎に画素数をカウントとしてヒストグラムを算出するヒストグラム算出手段と、該算出されたヒストグラムの平均値および分散を算出し、該算出された平均値に応じて入出力特性データを算出し、前記ヒストグラムの分離に応じた所定の割合で前記先に算出された入出力特性データに加算して前記入出力特性変換のためのデータと得る入出力特性算出手段と、該得られた入出力特性変換のためのデータにより前記遅延手段で遅延された映像信号を前記電子ディスプレイの特性に合わせて入出力特性変換する入出力特性変換手段とを備えていることを特徴とする電子ディスプレイの映像表示処理装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明はテレビジョン等に用いる電子ディスプレイ（ＬＣＤ（液晶ディスプレイパネル）やＰＤＰ（プラズマディスプレイパネル）等）における映像表示処理技術に係り、特に詳しくは電子ディスプレイの高画質化を図る電子ディスプレイの映像表示処理方法およびその装置に関するものである。

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【0002】

【従来の技術】入力映像信号による映像を電子ディスプレイ、例えば液晶ディスプレイパネル（以下ＬＣＤと記す）やプラズマディスプレイパネル（以下ＰＤＰと記す）に表示する場合、電子ディスプレイの特性（ガンマ特性等）に合わせて入力映像信号を所定に信号処理する。

【0003】この信号処理にあっては、例えばテレビジョン等の映像信号（ＲＧＢディジタル映像信号）に対して一般にガンマ補正のための入出力特性変換処理を行い、同映像信号による適正な映像を電子ディスプレイに表示可能とする。

【0004】

【発明が解決しようとする課題】ところで、上記電子ディスプレイのうちＬＣＤやＰＤＰは、他の電子ディスプレイと比較すると、その表示映像のコントラストや輝度が一般に不足しており、良好な映像を得ることが難しいのが現状である。

【0005】また、上記電子ディスプレでは寿命等を考慮して消費電力を一定に抑えるようになっているため、例えば表示映像が全体的に明るくない場合、つまり画面全体が暗い場合には表示映像のピークの輝度も低くなり、表示映像の画質が低下し、例えば黒つぶれの状態となる。

【0006】この発明は上記課題に鑑みなされたものであり、その目的は表示映像の黒つぶれ、白つぶれを抑え、かつ画面のコントラストを改善することができ、高画質の映像を得ることができるようにした電子ディスプレの映像表示処理方法およびその装置を提供することにある。

【0007】

【課題を解決するための手段】上記目的を達成するために、この発明の電子ディスプレイの映像表示処理方法およびその装置は、入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換する際、同入力映像信号により同じ信号レベル毎に画素数をカウントしてヒストグラムを作成し、該作成されたヒストグラムの平均値や分散を得、該得られた平均値や分散に基づいて入出力特性データを決定し、前記入出力特性変換のためのデータとしたことを要旨とする。

【0008】

【作用】上記手段によれば、入力映像信号の輝度信号により同入力映像信号の同じ信号レベル毎に画素数がカウンタでカウントされ、かつ、1フィルード（あるいは1フレーム）ごとに合計されて入力映像信号（同じ信号レベル）のヒストグラムが作成される。このヒストグラムの平均値および分散が入出力特性算出手段で算出されるとともに、この平均値および分散に基づいて入出力特性データが算出される。

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【０００９】この場合、上記入出力特性データは例えばｙ＝１／２・（（ｘ／ｃ）のγ乗）で得られるが、このｃ値はヒストグラムの平均値に応じて決定され、γ値はヒストグラムの分散に応じて決定される。一方、そのヒストグラムの累和が算出され、この累和をその分離に応じた所定の割合で上記先に算出された入出力特性データに加算される。この入出力特性データにより入力映像信号が電子ディスプレイに入力可能に入出力特性変換（ガンマ補正を含む）される。

【００１０】このように、入力映像信号を入出力特性変換するためのデータとしてはヒストグラムの平均値および分散に応じて決定されていることから、画面の黒つぶれが抑えられ、かつ白つぶれが抑えられ、コントラストの良好が映像が得られる。

【００１１】しかも、ヒストグラムの分布状態が多峰と複雑であっても、ヒストグラムの累和をその分離に応じた所定の割合で先に算出された入出力特性データに加算して最終的な入出力特性データとしていることから、よりコントラストが増大し、高コントラストの映像が得られる。

【００１２】

【実施例】この発明の電子ディスプレイの映像表示処理方法およびその装置は、入力映像信号（ＲＧＢディジタル映像信号）の同じ信号レベル毎に画素数をカウントして得られるヒストグラムの平均値（ＡＰＬ；平均映像レベル）およびその分散（または標準偏差）により画面の明るさ等を判断することができ、つまり画面の明るさ等がその平均値および分散に反映されることに着目し、入力映像信号による映像を電子ディスプレイに表示するために同入力映像信号を入出力特性変換する際、そのＡＰＬおよび分散に基づいて入出力特性データを算出する一方、そのヒストグラムの累和をそれぞれ算出し、各累和を所定の割合で先の入出力特性データに加算して上記入出力特性変換のためのデータを１フィールド（あるいは１フレーム）毎に決定する。

【００１３】そのため、図１に示すように、この電子ディスプレイの映像表示処理装置は、入力映像信号（ＲＧＢディジタル映像信号）を１フィールド遅延する１フィールド遅延部１と、この遅延された映像信号に対して入出力特性変換処理（ガンマ補正等）を行うためのＲＡＭ２ａ，２ｂ，２ｃからなる入出力特性変換回路２と、入力映像信号の輝度信号を検出する輝度信号検出回路３と、この検出された輝度信号により映像信号の信号レベル毎に画素数をカウントして１フィールド毎にヒストグラムを算出するヒストグラム算出回路４と、この算出されたヒストグラムの平均値、つまりＡＰＬ（平均映像レベル）および分散（または標準偏差）を算出し、これらＡＰＬおよび分散に基づいて入出力特性データを算出する一方、ヒストグラムの累和を算出し、該累和をその分離に応じた所定の割合で先に算出された入出力特性データに加算して入出力特性変換回路２の最終的な入出力特性データ（映像信号を入出力特性変換するためのデータ）を算出する入出力特性算出回路５とを備えている。

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【００１４】なお、ヒストグラムは、図２の実線曲線および図３の破線曲線に示すように、各入力映像信号のレベルに対して算出される。

【００１５】次に、上記構成の電子ディスプレイの映像表示処理装置の動作を図２および図３の特性図を参照して詳しく説明すると、例えばテレビジョン信号（ＮＴＳＣ信号）を所定処理したＲＧＢディジタル映像信号（８ビットないし１０ビットのＲＧＢ映像信号）による映像を電子ディスプレイ（ＬＣＤやＰＤＰ等）に表示するものとする。

【００１６】このとき、１フィールド遅延部１はそのＲＧＢディジタル映像信号（以下入力映像信号と記す）を１フィールド遅延して入出力特性変換回路２に出力する。一方、輝度信号検出回路３は入力映像信号の６ないし８ビット分のデータ（上位６ないし８ビットデータ）を入力して同入力映像信号の輝度信号を検出する。ヒストグラム算出回路４はカウンタであり、その検出された輝度信号により入力映像信号の同じ信号レベル毎に信号数をカウントし、かつ１フィールド毎に合計してヒストグラムを作成する（例えば図２に示す）。

【００１７】なお、入力映像信号がＮＴＳＣ信号によるものである場合、輝度信号検出回路３で検出される輝度信号Ｙは通常Ｙ＝０．３０Ｒ＋０．５９Ｇ＋０．１１Ｂの割合であるが、この発明ではその輝度信号がＹａ＝Ｒ＋Ｇ＋Ｂであってもほぼ同様の効果が得られる。

【００１８】また、そのヒストグラムを作成するための信号レベルは出力信号、つまり入出力特性変換して出力する信号が８ビット構成である場合、６ビットないし８ビットで十分である。

【００１９】さらに、そのヒストグラムの度数（出力レベル）を得るための画素ブロックは、ＮＴＳＣ信号による映像を一般的な４８０×６８０画素で表示する場合３２×３２画素ブロックを１つとし、つまりその画素ブロックの１画素を代表としてＡＰＬおよび分散値を算出しても、上記同じ信号レベル毎に画素数をカウントして得られるヒストグラムの場合とそれほど変わらない。したがって、１／１６×１／１６ないし１／３２×１／３２画素から１画素を取ってヒストグラムを算出するようにしてもよい。

【００２０】入出力特性算出回路５は、上記１フィールド毎に算出されたヒストグラムによりその分散およびＡＰＬを算出するとともに、この分散に応じて入出力特性のγ値（０．１～６．０）を決定し、そのＡＰＬに応じて当該装置の出力レベルが最大の１／２となる値ｃを決定する。さらには、それら決定されたγ値および値ｃに基づいて下記数１により入出力特性変換のためのデータを算出して入出力特性変換回路２の各ＲＡＭ２ａ，２

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b，2cにそれぞれ書き込むことになる。

【0021】

【数1】

$$y = \frac{1}{2} \times \left(\frac{x}{c}\right)^{\gamma}$$

上記数1において、yは入出力特性変換の出力レベル、xは入出力特性変換の入力レベル、cはy＝1／2となる値、γはγ（ガンマ）値を意味する。

【0022】この場合、入出力特性算出回路5では、上記算出されたヒストグラムを一旦内部のRAMに記憶した後、このRAMのデータを演算処理手段（MPU）に取り込んで上記数1に示す一定の数式にしたがって入出力特性の値（データ）を計算する。なお、上記数1では、高レベルの所定値（データ）が出力レベルを越えるとき、例えば上記数1と滑らかにつながる楕円の式を用いればよい。

【0023】一方、ヒストグラムの累和をその分離度に応じた所定の割合で先に算出された入出力特性データ（数1で算出された入出力特性データ）に加算する。

【0024】結果として、ヒストグラムが例えば図2の実線曲線に示す形である場合、ヒストグラムの累和による所（同図の矢印A，Bに示す部分）の入出力特性のγ値が大きくなり、つまり図3の実線曲線に示す入出力特性データとする。なお、上記所定の割合で加算する際、各峰のヒストグラムの分離に応じて一定の割合とし、出力のヒストグラムの分離が過度になり、原映像信号による映像を損なわないようにする。

【0025】この図3の実線に示す入出力特性データが入出力特性変換回2の各RAM2a，2b，2cに1フィールド毎に書き込まれ、1フィールド遅延されている入力映像信号がその入出力特性データにしたがって入出力特性変換される。したがって、表示画像のコントラストが増強され、つまりコントラストが改善されることになる。

【0026】このように、入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換する際、入力映像信号（RGBディジタル映像信号）の輝度信号により1フィールド毎に同映像信号のヒストグラムを作成し、このヒストグラムの分散やAPLに基づいて入出力特性データを算出するだけでなく、そのヒストグラムの分離に応じてその累和を所定の割合で上記先の入出力特性データに加算して入出力特性変換回路2の最終的な入出力特性データを得る。

【0027】したがって、例えばダイナミックレンジの小さいPDP等の電子ディプレイであっても、表示映像の黒つぶれ、白つぶれを抑え、かつ表示映像のコントラストを改善することができ、ひいては高画質の映像を得ることができる。

【0028】また、ヒストグラムが多峰の形である場合でも、表示映像のコントラストが増強され、つまり画面

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のコントラストを改善することができ、しかも原画像に極めて近く、高コントラストの画像が得られる。

【0029】例えば図3の破線曲線に示すように、ヒストグラムの分離が大きいときには、ヒストグラムの累和による入出力特性の成分が多くなり、つまり同図の実線曲線に示すように各峰に対応する部分のガンマ値が大きく、逆に各峰間の部分のガンマ値が小さくなるからである。

【0030】なお、上記実施例では、入力映像信号の1フィールド毎に入出力特性変換回路2の入出力特性データを算出し、同1フィールド毎に入力映像信号を入出力特性変換（ガンマ補正を含む）しているが、入力映像信号の1フレーム毎に入出力特性のデータを得るようにしてもよい。この場合、各回路をその1フレーム毎に処理可能な構成とすれば、上記実施例と同じ作用、効果を得ることができる。

【0031】

【発明の効果】以上説明したように、この発明は、入力映像信号を電子ディスプレイの特性に合わせて入出力特性変換して映像を表示可能とする電子ディスプレイの映像表示処理方法およびその装置で、入力映像信号による映像を電子ディスプレイに表示するために同入力映像信号を入出力特性変換する際、そのAPLおよび分散に基づいて入出力特性データを算出する一方、そのヒストグラムの累和を分離に応じた所定の割合で先の入出力特性データに加算して上記入出力特性変換のためのデータを1フィールド（あるいは1フレーム）毎に決定するようにしたので、例えばダイナミックレンジの小さいPDP等の電子ディプレイであっても、表示映像の黒つぶれ、白つぶれを抑え、かつ表示映像のコントラストを改善することができ、ひいては高画質の映像を得ることができ、またヒストグラムが多峰の形である場合でも、表示映像のコントラストが増強され、つまり画面のコントラストを改善することができ、しかも原画像に極めて近く、高コントラストの画像が得られる。

【図面の簡単な説明】

【図1】この発明の一実施例を示す電子ディスプレイの映像表示処理装置の概略的部分ブロック線図。

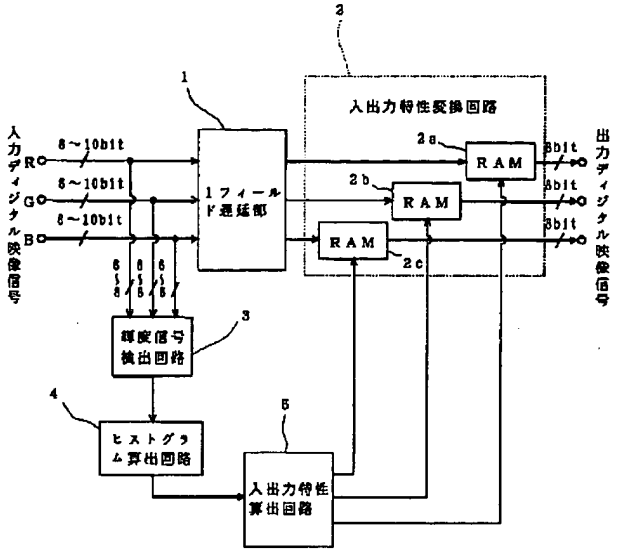
【図2】図1に示す映像表示処理装置の動作を説明するための概略的ヒストグラム図。

【図3】図1に示す映像表示処理装置の動作を説明するための概略的入出力特性図およびヒストグラム図。

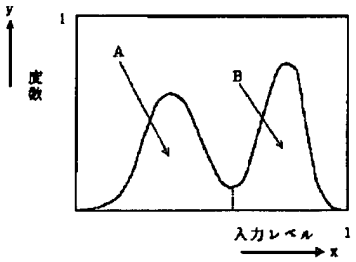
【符号の説明】

1　1フィールド遅延部
2　入出力特性変換回路
2a，2b，2c　RAM
3　輝度信号検出回路
4　ヒストグラム算出回路
5　入出力特性算出回路

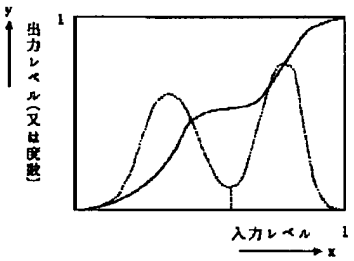
【図1】


3
1
入出力特性変換回路
入力ディジタル映像信号
R
G
B
8～10bit
8～10bit
8～10bit
1フィールド遅延部
2a
2b
2c
RAM
RAM
RAM
8bit
8bit
8bit
出力ディジタル映像信号
8→5
8→5
8→5
輝度信号検出回路
3
4
ヒストグラム算出回路
5
入出力特性算出回路

【図2】


y
1
度数
A
B
入力レベル
1
x

【図3】


y
1
出力レベル(又は度数)
入力レベル
1
x